

# The Distribution and Breeding Habits of Petrels in Northern New Zealand.

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The eastern coastal waters of Northern New Zealand, between the parallels of 34° and 38° South Latitude, may be considered as a well-defined feeding and breeding area for petrels. It is characterised by extensive areas of semi-sheltered water along the east coast, and a large number of islands suitable for nesting. Of the species breeding here, a number are resident and apparently restricted to the area, many are transequatorial migrants, and only two truly subantarctic genera (*Pelecanoides* and *Pachyptila*) are represented. An attempt is made in this paper to define the breeding dates accurately, to indicate the range of a species within the area, and put on record all observations to date on the habits of the birds. No discussion of the status or relationships of any of the species has been attempted. The data may not prove to be applicable to such breeding areas further south as Cook Strait, Bank's Peninsula, and Stewart Island. Many of the transequatorial migrants inhabit these areas for breeding in common with the northern area under discussion, but as regards what may be termed resident species the various areas are not contiguous and have their own distinguishable forms and characteristic species.

I am much indebted to Mr. Bernard Sladden, of Taneatua, for permission to quote his reliable records from the Bay of Plenty, and for the many opportunities of visiting islands there in his company; also to Messrs. W. R. B. Oliver and E. F. Stead for permission to quote unpublished records. Where I have not personally observed evidence of a species breeding the authority for the record is quoted.

The assumption that certain species are transequatorial migrants is based on observation of their regular arrival and departure, and on records of their occurrence in the northern hemisphere during the period of absence from these waters. Resident species are so described as the result of observation of their movements in every month of the year. On this basis the thirteen species to be dealt with may be classified as follows:—

Transequatorial Migrants.	Resident Species.	Unclassified for want of definite data.
<i>Puffinus carneipes</i> <i>Puffinus bulleri</i> <i>Puffinus griseus</i> <i>Pelagodroma marina</i> (probably)	<i>Pterodroma macroptera</i> <i>Puffinus gavia</i> <i>Puffinus assimilis</i>	<i>Pelecanoides urinatrix</i> <i>Pachyptila turtur</i> <i>Procellaria parkinsoni</i> <i>Pterodroma inexpectata</i> <i>Pterodroma cooki</i> <i>Pterodroma pycrofti</i>

Among the published records dealing with this area, Sandager's paper (1889, p. 286) contains records, from Mokohinau, which can all be confirmed by observation at the present day. On the other hand it should be pointed out, in the interests of accuracy, that Reischek's observations, so extensively quoted, cannot be fully confirmed in the same way. While much of his observational work forms an invaluable field record, a number of his statements regarding the breeding seasons and the habits of some species are completely at variance with contemporary observations, as well as with more recent ones, and some cases in point are quoted below.

### **Pelecanoides urinatrix** (Gmelin).

*Breeding stations:* Three Kings Islands (Fraser), Cavalli Islands, Poor Knights Islands, Mokohinau and Fanal Island, Bream Rocks, Chickens Islands, Channel Island, Alderman Islands, Karewa Island, Motuotau (Rabbit Island), Plate Island.

*Breeding dates:* The annual moult of adult birds is usually complete in March, and large flocks are to be seen at sea near the breeding places from April onwards. For the next three months they are engaged in a leisurely cleaning out of burrows, carried on mainly at night. Odd birds, usually males, are sometimes found in the burrows during the day during this period. One male bird taken from a burrow on one of the Chickens Islands in April was in fresh plumage and had enlarged gonads, although in this area actual laying does not commence until July at the earliest. At Karewa Island practically all the birds had laid by the end of August, 1925 (Sladden). An incubation period of at least five weeks is suggested by the fact that on the same island on 5th October of the same year Sladden could find no chicks, although several eggs were just ready to hatch. Most of the young leave the nests on this island at the end of November, but on islands further north the season is more extended and numbers are still leaving throughout December. Nothing has been recorded of their movements and habits from January to March, during which time they are rarely seen at sea in coastal waters. This is the season of moult.

*Breeding habits:* Throughout the breeding season, diving petrels, which arrive always after dark, fly straight in from the sea without preliminary circling, and land heavily within a few feet of the home burrow. Their courtship is noisy, with both mewing and cooing notes. It often takes place, as does pairing, outside the burrows. For nesting material the most readily available is used, and Sladden mentions the leaves of *Coprosma retusa* as used on Karewa, quantities being knocked off the bushes as the birds hurtle in. After the eggs are laid, the birds coming and going at night, make much less noise. On many of the islands larger species begin to nest before the diving petrels have finished, and there are few places in which the latter have an area to themselves for the whole season. Mr. Sladden is of opinion that on Karewa diving petrels sometimes occupy the

larger burrows made by *Puffinus carneipes*, and Buller quotes Captain Fairchild as having found a pair of the latter in November in the same burrow as a fledgling diving petrel.

*Development of young:* The smaller nestling figured (Pl. 54, fig. 2) is from Mokohinau, on 4th October. It is covered with protoptyle down, silver grey above and white on throat, chest and abdomen. Murphy (1921, p. 210) has described *P. urinatrix* as similar to *P. georgicus* in having dark protoptyle, but this is not so. The next stage figured (Pl. 54, fig. 1) is a bird from Cavalli Islands on 5th November. It is heavily clothed with mesoptyle down, loose and dark brownish grey on the upper parts, and short, dense and sooty grey below. Teleoptyles are already well developed on head and wings, the secondaries being white edged at the tips, and some of the short outer scapulars with pale grey inner webs.

*Food:* There is very little food in the stomachs of adults early in the nesting season. Later, when feeding the young, and after the post-nuptial moult, they contain quantities of fine paste made up of various pelagic Crustacea. This is the only species of petrel in which I have not yet found remains of cephalopods.

### **Pelagodroma marina** (Latham).

*Breeding stations:* Cavalli Islands, Mokohinau, Noises, Gannet Rock, Mercury Islands, Alderman Islands (Hongiora).

*Breeding dates:* After an absence of five months from these waters, the first flocks of white-faced storm petrels appear about the middle of August. The dates given by Sandager for Mokohinau apply exactly to all the other breeding islands listed above. Laying takes place from about the 20th until the end of October, the young are hatched at the end of November, and begin to show feathers during January. At the Noises islets on 3rd March, 1934, two-thirds of the burrows were empty and the youngest bird found was within less than a week of flying.

*Breeding habits:* During September the birds are very common at sea, and are to be seen engaged in erratic mating flights more often than feeding. They not infrequently lose their way in thick weather during this period, and fly into lighthouses or passing ships, but usually without damaging themselves. The nesting burrows vary in length, some being quite shallow. The large quantity of nesting material used results in the egg being kept dry and usually quite clean. I have found surface laid eggs at most of the breeding places, and on one of the Noises islets a nest of leaves out in the open, under trees, with a male bird sitting closely on a well-incubated egg. This was on 2nd December, and in broad daylight.

At no time during the nesting season do the birds appear to come in until well after dark. At the Mercury Islands on 5th January, 1926, when feeding young, the majority arrived about



9 p.m., an hour after dark. At this time they are not noisy, uttering a low twittering note after alighting, but by 10 p.m. louder squeaking calls are to be heard. I am unable to state whether both parents visit the young on the same night. In marked burrows only one adult was found at any one time.

*Development of young:* The newly hatched nestling is covered with ash grey down of uniform shade above and below, and very long and bushy on the forehead and crown; chin and throat naked. The distinguishing features of the first teleoptyle plumage succeeding the down are the grey-white edging of the secondaries, and the white tips of the major wing-coverts. At this stage also the webs of the toes are usually buff pink, and not yellow, as in adults.

*Food:* The stomachs of several sitting adults of both sexes in October were found to be empty except for small pebbles. Food in the stomach of nestlings consists of a fine paste in which the only recognisable remains are of minute crustacea. The stomachs of newly-fledged birds ready to leave the nest were found to be empty, but such birds immediately after death discharge about a fifth of a fluid ounce of clear, reddish orange oil from the mouth. Small cephalopod beaks have been taken from the stomachs of adults at various seasons.

### ***Pachyptila turtur* (Kuhl.).**

Only one form of the fairy prion is so far recorded from this area. It is not distinguishable from the form breeding in Cook Strait and at the Chatham Islands. It is not common even near the breeding places listed, and appears to be absent from the Bay of Plenty.

*Breeding stations:* Poor Knights Islands, Chickens Islands (Reischek), off Great Barrier.

*Breeding dates:* At the Poor Knights I have found new burrows, on 17th November, and Oliver has recorded a heavily incubated egg there on 3rd December. Sladden (in lit.) has found well grown chicks in down on Saddle Island, off Great Barrier, at the end of January, so that the breeding season would seem to be fairly uniform throughout the area.

*General:* Up to the present time no further facts about prions breeding in this area have been recorded. By February countless numbers of prions of several species reach these waters from further south, and it becomes impossible to trace the movements of the local birds. As their condition on leaving the nest and plumage changes are probably similar to those of the birds inhabiting Cook Strait, I may here give the results of an examination of some Stephen Island material, for which I am indebted to Mrs. Moncrieff, of Nelson. The material consists of the complete heads, with plumage attached, of a number of adult and juvenile birds which had been killed by cats on or about 25th January,



1932. The bill measurements of the various stages represented are as follows:—

No.	Stage of Growth.	Length of Bill.	Width of Bill.
1	Adult.	24 mm.	10.5 mm.
2	Adult.	23	11
3	Adult.	23.5	12
4	Young, almost fully fledged.	20.0	8.5
5	Young, fully fledged, wisps of down on neck.	22.0	9.0

At the time a young prion leaves the nest it is still distinguishable from the adult, not only by a bill of smaller dimensions, which when dry after death presents a shrunken appearance along the top of the culmen, but also plumage of a pale bright blue, which later becomes darker and greyer through wear. Birds in this condition are frequently driven ashore during gales in February, and their immaturity can always be verified by dissection.

***Puffinus carneipes* (Gould).**

*Breeding stations:* Three Kings Islands (probably), Chickens Islands, Mercury Islands, Alderman Islands, Karewa.

*Breeding dates:* After an absence of three or four months in the winter, the first of these shearwaters are noticed at sea off the coast early in September, and they remain in the neighbourhood of their nesting islands throughout the summer. A few go ashore at night to work on new burrows or clean out old ones during September, and by the beginning of October about half the burrows have been "claimed." Early in November all the birds seem to come ashore every night, and by the end of the month laying has commenced, continuing until about 10th December. Hatching commences about 12th January. Half-grown nestlings have been found on 24th February (Chickens Islands), and full-grown nestlings still in down on 10th March (Karewa). From this date they begin to feather and are fed less frequently. Most of the burrows are empty by the beginning of May, and the birds are no longer to be seen at sea, at any rate in coastal waters.

*Breeding habits:* At the nesting places these shearwaters approach the land before dark, and begin to come ashore at dusk. On 5th October at Karewa, Sladden noticed a fair amount of activity at night, but very little noise. Many burrows on that date contained pairs of birds, and in a few, single birds were found during the day. Throughout November, when burrowing and collecting of nesting material is finished, the din at night associated with courtship and mating is considerable. The birds begin to call before alighting, a short mewling note like that of a kitten. Mating displays begin after dark on the ground near

the burrows, and it is somewhat difficult on account of the large numbers involved to isolate the participants in any particular display. A high pitch of excitement is reached by many of the birds, and they waddle about with swaying necks thrust forward, uttering a guttural purring note, with sobbing intake. The noisiest part of the demonstration is reached when each pair strikes an ecstatic attitude, with beaks close together, and sets up a duet of loud squeals. During January, when the birds are coming in at night to change guard, they arrive later, and when bringing food for the young often later still. There seems a tendency on windy days for food-gathering birds to work away from the home island in the morning into the wind. On a day when a south-west wind registered a steady force 5 (Beaufort Scale) I have seen many of these shearwaters late in the afternoon still feeding at a point 80 miles to the south-west of the nearest breeding island. The obvious advantage of this habit is that the birds can feed more easily when moving head to wind, and, further, that they have the wind with them when flying back heavily laden with food.

*Development of young:* A half-grown nestling from the Chickens Islands is covered with sooty grey down, uniform above and below, and has a fleshy purple bill, dark at the tip, and dull fleshy pink feet. The condition of a well-grown nestling on Karewa Island on 10th March is figured by Oliver (1930, p. 117), who reproduces a photograph taken by Mr. Sladden on that date. A young bird from the same island on 30th March, with wing feathers just beginning to show, has long silky mesoptyle down on the back, darker brown than the protoptyle that it has replaced.

*Food:* Adults captured in December almost invariably have the alimentary tract filled with a substance like bright green mud, of which the nature and origin have not been determined. Cephalopod beaks of various sizes are often found in the stomachs of adults.

An acquired habit, most noticeable in April, is the regular attendance of many shearwaters of this species only on boats engaged in line fishing. In addition to picking up scraps, the birds dive down and follow the bait on a sinking line to a depth of ten or fifteen feet, usually getting it or hooking themselves.

### **Puffinus bulleri** Salvin.

*Breeding stations:* Three Kings Islands (probably), Poor Knights, off Great Barrier (?), off Mayor Island (?), Whale Island (probably).

Although to date the Poor Knights is the only breeding place definitely recorded, there is no doubt that colonies also breed at the Three Kings and at Whale Island. At both these places I have seen large numbers of birds closing in on the islands at sunset, and also flying out from the shore at daybreak.

*Breeding dates:* The first Buller shearwaters arrive at the end of August, and others throughout September. Preparation of burrows probably begins in October, and I have found at the Poor Knights on 17th November evidence of fresh burrowing, and collected nesting material, but no birds in the burrows by day, and no eggs. The first week in December seems to be fairly uniformly the laying time, and most of the chicks hatch before the end of the month. By 24th February the chicks are large, but still clothed in down, with no feathers showing. They are fledged and leave the nests about the end of March, and by the end of April very few birds of this species are to be seen at sea.

*Breeding habits:* No detailed observations have been made other than those recorded by the present writer (1924, p. 37). As the breeding season coincides with that of *Puffinus carneipes*, so also do the habits of this species seem to correspond fairly closely. This applies to the mewing call made when approaching land after dark, and to some of the feeding habits. *Puffinus bulleri*, however, has not been seen to approach the nest just before dark, as *P. carneipes* sometimes does.

*Development of young:* The only material so far examined are four well grown nestlings in down taken at the Poor Knights on 24th February. These birds, collected from different parts of the island, are fairly uniform in size and colour of down, which is a neutral grey, only slightly darker above than below (Pl. 55, fig. 1). Bill and feet are coloured as in the adult, but more fleshy and with dark parts less pigmented.

*Food:* The stomachs of adults taken early in December contained cephalopod beaks and small sharp pebbles, and birds on the nests later in the month had an unidentified green substance in the alimentary tract, which is possibly not food, but a secretion like bile.

### ***Puffinus griseus* (Gmelin).**

*Breeding stations:* Three Kings, Cavalli Islands, Mokohinau (Sandager), Hen Island (Stead), Alderman Islands, Whale Island, White Island (Sladden).

Although breeding regularly on all the islands named, the sooty shearwater is not common on any of them, and the number of burrows of this species on any of the islands would not be more than a dozen. Consequently only scattered birds are to be seen at sea during the summer in this area, associated with other petrels often, but never seen in flocks composed of their own kind, as at the southern breeding areas.

*Breeding dates:* These correspond with those of the other two long distance migrant shearwaters. The birds begin to come ashore at the breeding places in October, and on 5th November at the Cavalli Islands Mr. Pycroft has found a male bird with enlarged gonads, occupying a burrow during the day. A nest containing a female bird and egg was found on Whale Island on



11th January, the state of incubation of the egg indicating that it had been laid not earlier than mid-December. A similar season elsewhere in this area is confirmed by the observations of Sandager at Mokohinau (1889, p. 290), Sladden and Falla (1928, p. 283) at Alderman Islands, and Sladden at White Island.

*Breeding habits:* Published accounts and observations agree that this species in this area burrows in harder ground than the others, and has generally deeper burrows. A burrow at Whale Island went down almost vertically for three feet, and then turned sharply to the left before opening into a roomy breeding chamber, where three or four handfuls of sticks, dry grass and leaves formed the nest. The habit of uttering a monotonous crooning note in the burrows during the day when sitting, especially on the approach of footsteps near the burrow, has been frequently observed. They resist vigorously if disturbed.

### ***Puffinus gavia* (Forster).**

#### ?***Puffinus gavia byroni* (Mathews).**

Birds from northern New Zealand are smaller than the birds from the type locality and Cook Strait, and may prove to be inseparable from the New South Wales birds which Mathews has referred to a subspecies *byroni*. These shearwaters outnumber every other species numerically, and are present all the year. A typical flock, off Three Kings Islands, is shown in Pl. 56, fig. 2.

*Breeding stations:* Three Kings, islets off Doubtless Bay, Poor Knights, Bream Island, Mokohinau, Chickens, Hen Island, Little Barrier, Saddle Islet, off Great Barrier, Channel Island, Mercury Islands, Alderman Islands, off Slipper Island, Plate Island, Whale Island.

*Breeding dates:* On all the islands above listed apparently the dates are those given by Sandager for Mokohinau. The moult of adults is protracted, beginning in January and often not complete until June. The majority of adult birds are ashore nightly by September, burrowing and courting. Fresh eggs are to be found at the end of that month and early in October. A nestling about half grown, described below, was taken at one of the Chickens Islands on 11th November, and fully fledged young with patches of down still adhering have been taken on 11th January (Whale Island). A young bird that had just left the nest was taken at Whangarei on 22nd January, a time of departure that observations elsewhere show to be general.

*Habits:* In March and April, while still in double-feather, these shearwaters frequent inshore and sheltered waters in vast numbers, feeding on the shoals of larval and post-larval fish (*Engraulis* and other species) which are plentiful at that time. When feeding thus on small fish the birds swim on the surface and frequently submerge their heads. They also dive and swim for considerable distances under water. When the fish go down the shearwaters rise and make a straight flight into the wind

with the rapid wing beats characteristic of the species, until they gain sufficient momentum to perform controlled gliding. At this stage they all wheel back until the rising fish are sighted again, when they round up once more into the wind and alight.

They are vocally more noisy than any other petrel in this region. Even at sea a flock will sometimes set up a cackling noise after the discharge of a gun. Approaching the nesting islands an hour or more after dark they begin to call when about two hundred yards off shore, and the burst of staccato notes then set up lasts till the bird lands on the ground. The notes when uttered slowly resemble the native name of the bird "pakaha"; their rapid repetition is like a wild burst of laughter. The burrows of this species vary with the kind of surface in which they are made. On Bream Island, for example, in soft soil they are comparatively shallow, close together, and on a bare knoll devoid of vegetation; on Hen Island frequently under large trees, winding under roots and rocks, and five or six feet long. I have not observed the courtship and early stages of nesting.

*Development of young:* The youngest nestling available for examination (Chicken Island, 11th November) is about half grown and covered, except for the naked chin and fore-neck, with uniformly coloured sooty grey mesoptyle. In specimens almost fully fledged the remnants of this down show no difference in colour. The first teleoptyle plumage resembles that of the adult, but is darker than that of even a fresh moulted adult bird, being on the upper parts a glossy blackish brown. Even at this stage, however, it could hardly be confused with the blue-black of *Puffinus assimilis*, as has been suggested in discussions on the taxonomy of *P. gavia*.

### ***Puffinus assimilis* Gould.**

Among several resident petrels that commence nesting before winter is over, this species appears to be the earliest to lay. It is not common at any season, and I have never seen it in flocks in coastal waters.

*Breeding stations:* Mokohinau, Chickens Islands (Reischek), Hen Island.

*Breeding dates:* On Hen Island A. T. Pycroft found a freshly moulted pair in a burrow during the day on 17th April. At Mokohinau on 5th October burrows of an extensive colony were all empty, except for two belated chicks, one in down, the other half-fledged. Adults in worn plumage and young in fresh first plumage were collected at sea on 17th November, and in the same month R. A. Wilson found odd birds in burrows on Hen Island, probably fully fledged young. These records all agree with Sandager's observations at Mokohinau, except that he describes the young as leaving the burrows fully two months later. Reischek (1885, p. 95), however, records the commencement of burrowing in October, the season ending with the departure of the young in February. If Sandager is correct the season must be

irregular and extended, or have altered slightly in fifty years. If Reischek is correct, either the season has changed from winter to summer, or the birds raise two broods in a year. Present day observations indicate *P. assimilis* as a winter breeder only, with season from April till October.

*Habits:* The period of field work covered by this paper has yielded little information about this species additional to what has been published. Its flight is rapid in still air, but the wing beats are not so rapid as in the heavy-bodied *P. gavia*, and it has more control when changing direction than that species.

An example of the optimism or patience of the male was afforded by a male *P. assimilis* found at Mokohinau on 5th October still sitting closely on an egg in which a well developed chick had been dead probably for a week or two.

*Development of young:* Reischek has described the down on "the very young of *P. assimilis* as light grey, the throat, breast and abdomen white." This is the protoptyle stage, and a well-grown nestling from Mokohinau still has a patch of white protoptyle adhering to the mesoptyle of the breast (Pl. 54, fig. 4). The full mesoptyle condition, however, is a dark grey both above and below (Pl. 54, fig. 3), the sequence of neossoptyle plumages being thus somewhat similar to that in *Pelecanoides urinatrix*. In its first teleoptyle the young is indistinguishable from a fresh moulted adult, except for its immature bill characters.

*Food:* Remains of small cephalopods and minute crustacea have been found in the stomachs of several.

### **Procellaria parkinsoni Gray.**

The superficial similarity of this species to *Puffinus carneipes* and *Pterodroma macroptera* introduces an element of uncertainty into all earlier records that are not supported by existing specimens. In view of its apparent restricted breeding area to-day and the infrequency with which it is seen, it must be accounted one of the rarest petrels in the world.

*Breeding stations:* Little Barrier Island, and possibly inland mountain ranges.

*Breeding dates:* The black petrel seems to be the latest breeding petrel in the area. Reischek records them as still cleaning out burrows on Little Barrier in November, and the finding of the first egg on 28th of that month. He further mentions very young birds in December, January and "even as late as April." A specimen collected by him on Little Barrier and dated "April, 1885," is in the Auckland Museum collection, and is clothed in dark brown (although possibly somewhat faded in the specimen) mesoptyle. Teleoptyle plumage is well grown on crown, ear-coverts, mantle, scapulars, upper wing coverts and breast.

It seems clear that the young leave the burrows mainly in May, for there is seldom a year when young birds are not picked



up in various parts of the Auckland district, having lost themselves in gales and fogs during that month and early June. The last one to reach the Auckland Museum was picked up injured in the city on 19th May, 1931. Its whole plumage is a rich, glossy, blackish brown, relieved by the paler or rather "frosted" edging to the feathers, especially of the mantle and back. The bill was ivory white, stained with black on the culmen, mandibular sulcus, and tip of mandible; feet entirely black, iris brown.

### ***Pterodroma macroptera* (Smith).**

Of this petrel it may be said that it breeds on every islet where burrows can be made, on all suitable cliffs along the mainland coast, and sometimes a mile or two inland. A full list of breeding places would include two or three hundred islands, islets and capes. It is not gregarious nor a colony-forming bird, like most of the shearwaters, and its abundance on certain islets is due to the suitability of the ground there. Elsewhere a single burrow may be found in some isolated spot. The species appears to be independent of food supply in coastal waters, and its extensive feeding range has been remarked upon in another paper (Sladden and Falla, 1928, p. 284).

*Breeding dates:* Within a month of the departure of the last of the young from the burrows in January, some few old birds will be found in occupation again, at first only single birds, and usually males. This is so in February and March. From April till June pairs are often found in burrows during the day, but not in all the burrows on any one day. Laying takes place at the end of July and early in August, and a few chicks are hatched before the end of August. Chicks reach their maximum size and condition late in October, and begin to feather. November is the "mutton-bird season" for this species, the only one now collected at all regularly for food by North Island Maoris. Young are fully fledged early in January, and are all away by the end of the month.

*Habits:* Their habits have been vaguely described by some writers as "nocturnal," apparently because they are often found in burrows by day. The position seems to be that a pair may remain for several days and nights in a burrow, and then spend a similar continuous period at sea. Although not common in coastal waters at any time, when they do appear they are frequently in pairs, especially in May. Their courtship has not been described, and I have not seen it. A large quantity of nesting material is sometimes used, and I have half filled a sugar-bag with the contents of one burrow. Although female birds are sometimes found sitting on quite fresh eggs, in the later stages of incubation only males have been found sitting, at any rate during the day. Males have also been found in attendance during the day on chicks up to ten days old, after which the chick is only visited at night.

Throughout the year, except perhaps in January, old birds may be heard calling at night near the nesting places, and among

several notes the predominant one is that represented by the native name "Oii." It is not unusual in January to find fully fledged young emerging from the burrows after dark and ambling about in an aimless fashion over tree stumps and other obstacles. They often return again to the burrow before daylight, but sometimes take wing.

*Development of young:* Chicks about ten days old collected at Tiri Tiri Island on 1st September were in uniform sooty grey down, and had black bills and fleshy grey feet. Two such specimens weighed respectively  $6\frac{3}{4}$  ozs. and  $8\frac{1}{2}$  ozs. A chick taken at Cuvier Island on 6th October weighed 12 ozs., and was still in down, with no feathers showing. Half-fledged young from the Cavalli Islands on 5th November weigh 1 lb. 2 ozs., and 1 lb. 6 ozs., the latter being 4 ozs. in excess of the normal adult weight. Before flying the young are reduced to about 3 ozs. less than adult weight. A young bird from Tiri, fully fledged, but still in the burrow on 22nd December, is of adult dimensions, viz., wing 302, tail 120, tarsus 41, toe 64, bill 37. Its plumage is indistinguishable from a fresh moulted adult, except in being perhaps a shade darker. The "frosted edges" of the mantle feathers are noticeable as in the fresh plumage of practically all dark petrels.

*Food:* In the stomachs of young and old, cephalopod remains are invariably found. Young birds when disturbed throw up considerable quantities, including pieces of flesh, beaks, eyeballs, and purple fluid.

### ***Pterodroma inexpectata* (Forster).**

This species evidently once nested in great numbers in the inland ranges of the North Island. There is reason to believe that many hearsay records of *P. cookii* from inland refer to this bird, perhaps on account of the native name "titi" being applied to both. There are authentic specimens of *P. inexpectata* taken inland, and none that I can find of *P. cookii*. Most of the extensive breeding areas once known to the natives are now deserted, on account of fire and vermin. Miss L. M. Cranwell informs me that the calls of petrels may still be heard at night on Maungapohatu Mountain, in the Urewera district.

In the area under discussion, *P. inexpectata* has been recorded as nesting only on Cuvier Island. In a letter to me dated 22nd July, 1923, the late Mr. R. S. Sutherland wrote: "At the present time at Cuvier mottled petrels (*P. inexpectata*) are becoming more frequent round the lighthouse at night—evidently congregating—but so far they have not touched the old burrows. Their nesting time, judging by observations I made on the West Coast, South Island, is October onwards." In another letter he wrote: "At Cuvier, *Pterodroma macroptera* seems to have monopolised all nesting sites—the only other petrel breeding in any number being *inexpectata*—and there are only odd ones of these; I mean there is no section of the island of which one can say—this is *inexpectata*—or this is *macroptera*."

On a visit to Cuvier on 7th October, 1933, I found freshly cleaned burrows under the roots of *pohutukawa* trees, but they were at that date unoccupied during the day. The only specimen I have collected in the area was picked up dead on a beach on Red Mercury Island, ten miles south of Cuvier, on 10th January.

### *Pterodroma cookii* (Gray).

Recent investigations have indicated the possibility of Little Barrier Island being the only known breeding place of *P. cookii*, and the strong probability that Reischek's records from the Chickens Islands refer to *P. pycrofti*. Reischek's observations on Little Barrier are likely to remain the chief source of information about the nesting of *P. cookii*, as no permits are now granted for the collecting or disturbance of any bird on this sanctuary. Such observations as can be made confirm the dates he gives, namely, a fresh egg on 2nd November, and the young full grown in March.

*Habits:* There are no records by any observer to show definitely whether *P. cookii* leaves these waters at any part of the year, but there is some indication that they do so. I have noted their presence in each month from October till March, their absence in August and late April, and have no record for the winter months. Such evidence is not conclusive, for even in the summer they may be seen at sea in thousands on one day, and then be absent for days at a time, probably feeding a hundred miles off-shore. They still nest in considerable numbers on Little Barrier, in spite of the fact that wild cats are still finding them easy prey. The burrows are mainly on the higher ridges of the island, and wind down deeply beneath roots into a rich black forest mould which is usually sodden with moisture.

*Development of young:* None of the nestling stages have apparently been described. A photograph of a well-grown bird in down taken by Mr. R. S. Lediard early in February is here reproduced (Pl. 55, fig. 2) and shows pale grey down above and white below. The first teleoptyle plumage of a bird not long from the nest, picked up on 2nd April, 1928, was described earlier in this volume (Falla, 1933, p. 178). An exactly similar bird has been found under similar conditions on 1st April this year (1934) near Auckland.

*Food:* Cephalopod beaks have been found in all the specimens I have examined.

### *Pterodroma pycrofti* Falla.

An opportunity is taken in this paper to present additional field observations on this species which should further help to distinguish it from the closely allied *P. cookii*.

The dimensional differences indicated in my earlier paper in this volume (p. 176) are confirmed by the larger series of both species now available. All the specimens of *P. pycrofti* have shorter wings, bills, and middle toes, but relatively, and in some



specimens, absolutely longer tails than *P. cookii*. The average weight of three breeding females of *P. pycrofti* was 5.65 ozs., and of two female *P. cookii* 6.75 ozs. The fresh material indicates that the type and paratype of *P. pycrofti* from Hen Island are darker than normal on account of wear. The fresh plumage of the upper parts is slightly darker than the neutral grey of Ridgway's standards, that of *P. cookii* being slightly lighter than neutral. In *P. pycrofti* the white edging to frontal feathers is confined to the forehead, not extending back over the crown, and the white mark over the eye is more extensive. The scalloped effect at the sides of the neck and breast of *P. cookii*, due to white edging of dark feathers, and grey flecks on some of the white feathers, is absent in *P. pycrofti*, the line of demarkation being more cleanly defined. The flanks axillaries and thighs are white, without the irregular mottling found in *P. cookii*. The inner web of the outer pair of lateral rectrices is pure white in all eight specimens. This is stated by Murphy (1929, p. 3) to be variably marked in *P. cookii*, but it is more or less mottled in all the specimens of *P. cookii* available for this comparison. The feet of *P. pycrofti* are pale lilac blue on the tarsus and the middle and inner toes, brown on the outer toe, webs of a transparent flesh colour, heavily veined with purple. The feet of *P. cookii* have the upper part of the tarsus and most of the inner toes dull purplish blue. The outer toe, patches on the inner toes and lower end of tarsus are brown. The outer two-thirds of the webs are opaquely stained with brownish black. In life *P. pycrofti* appears a shorter bird, with a smaller, more rounded head.

*Breeding stations:* Hen Island, Chickens Islands.

*Breeding dates:* The conditions of the earlier discovery of this species, when a pair were found in a burrow on 25th January (Falla, 1933, p. 176) were evidently abnormal, and Mr. E. F. Stead has subsequently determined that laying at both known breeding places commences at the end of November and continues through December, which appears to be some weeks later than that of *P. cookii*. A brief search for young in February this year was unsuccessful, as the only burrows found were either empty or contained punctured egg shells, and in two cases dead birds, perhaps the work of rats.

*Habits:* Very little information about the range and habits of this species has yet been obtained. The situation of the nesting burrows, however, offer a striking contrast to those usually occupied by *P. cookii* on Little Barrier. The burrows so far discovered are not anywhere close together, but in small groups in dry, well drained ground. Some of them are comparatively shallow, and in many dead leaves have been allowed to accumulate at the entrances in such quantity as almost to block them. Even when the birds are in occupation they present externally the appearance of old disused burrows. The call *tee-tee-tee* has been heard at the Chickens and Hen Island, and as *P. cookii* has not been found at either place, it is apparently made by *P. pycrofti*.

*General conclusions:—*

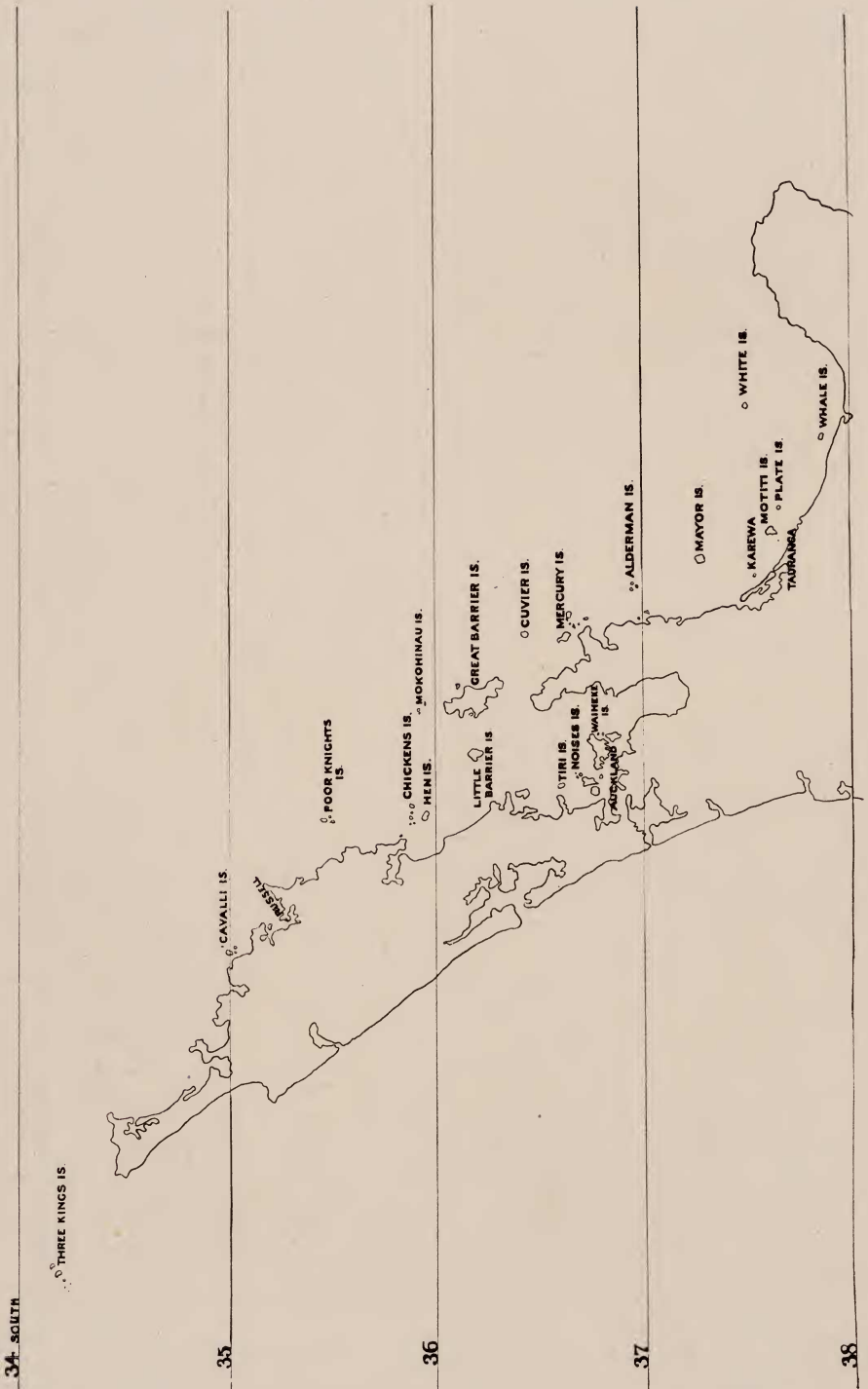
The main factor governing the breeding dates of the various species here considered appears to be the extent of the annual migration, if any. Thus none of the species that have been recorded at the equator or north of it are found to lay before November, except *Pelagodroma marina*, which lays at the end of October. Furthermore, there is marked regularity about the laying dates of such species, and the preliminaries of courtship and burrowing occupy a shorter time. On the other hand, the species listed above as resident breed in the winter, at any time from April onwards, and have a more extended season, with some irregularity in the dates of laying. Judging by these criteria and from other indications, the species in the unclassified list given above might tentatively be regarded as probably migratory, with the exception of *Pelecanoides urinatrix*, which is probably resident. Some observations on these lines have recently been published by Major R. A. Wilson in the "Wanganui Chronicle" of 13th March, 1934.

In the matter of food supply there is not the competition that might be expected where such a large number of birds of similar habit are confined to a small breeding area. Examination of stomach contents and observations of the birds at sea show that many species are to some extent specialised in their feeding habits. Thus *Puffinus gavia*, and to a lesser extent *Puffinus carneipes*, seem better able than the others to obtain young fish. An almost exclusive diet of pelagic cephalopods seems to be the rule with the larger species of *Pterodroma*, and of these *P. macroptera* is rarely, and *P. inexpectata* practically never, seen within fifty miles of the coast during the day.

Although conditions of temperature and food supply seem superficially much the same throughout the area, the waters of the Bay of Plenty, from Cuvier Island south, may be regarded as a sub-area in which it will be noted that several species do not breed. Those not so far recorded from there are *Pachyptila turtur*, *Puffinus assimilis*, *Procellaria parkinsoni*, *Pterodroma cookii* and *Pterodroma pyrofti*. The Bay of Plenty sub-area has no species breeding there that are peculiar to it.

## LITERATURE CITED.

- Falla, R. A. Emu, vol. 24, July, 1924.  
 Falla, R. A. Rec. Auck. Inst. Mus., vol. 1, No. 4, Sept., 1933.  
 Murphy, R. C. Bull. Am. Mus. Nat. Hist., vol. XLIV., Art. XVII., 1921.  
 Oliver, W. R. B. New Zealand Birds, 1930.  
 Reischek, A. Trans. N.Z. Inst., vol. XVIII., 1885.  
 Sandager, F. Trans. N.Z. Inst., vol. XXII., 1889.  
 Sladden, B., and Falla, R. A. N.Z. Journ. Sci. Tech., vol. IX., Nos. 4 and 5, 1928.



Map of North Auckland and Bay of Plenty coast, with off-shore islands.



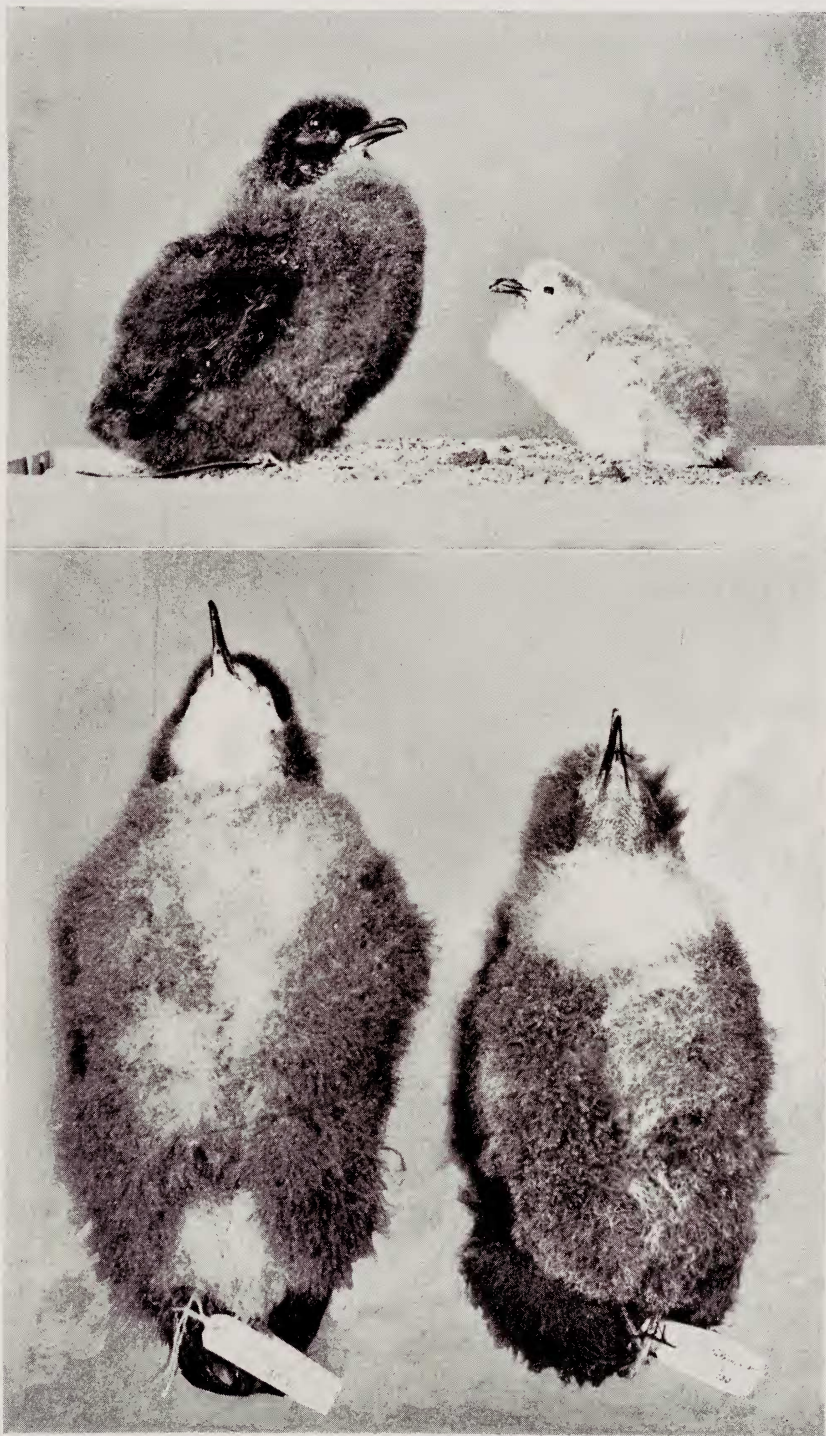


Fig. 1. Mesoptyle down of *Pelecanoides urinatrix*.

Fig. 2. Protoptyle down of *Pelecanoides urinatrix*.

Fig. 3. Mesoptyle down of *Puffinus assimilis*.

Fig. 4. *Puffinus assimilis*: younger specimen with patch of white protoptyle still adhering to grey mesoptyle.



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Fig. 1. *Puffinus bulleri* nestling, Poor Knights Islands. Photo by courtesy "The Weekly News."

Fig. 2. *Pterodroma cookii* nestling, Little Barrier Island. Photo by R. S. Lediard.





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Fig. 1. Typical nesting site of *Puffinus bulleri*, Poor Knights Islands.  
Fig. 2. Flock of *Puffinus gavia* (with *Larus scopulinus*) off Three Kings Islands.  
Photos by courtesy "The Weekly News."